RECLAIMING GIN-LOSS COTTON

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RECLAIMING GIN-LOSS COTTON

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INTRODUCTION

Gin-loss cotton is a byproduct of the ginning process, and its utilization has received increased attention in recent years. Lint cleaners, used in all modern gins, are the main source of gin-loss cotton. Gin stand moting systems are another source of this material in the gin plant.

PROBLEM

Natural, or uncleaned, gin-loss cotton consists of three main components—trash, motes, and fiber. The trash content varies widely, depending on field conditions at time of harvest, method of harvest, and processing treatment used in ginning. Motes are immature seeds with short, immature fibers attached. They are the result of conditions under which the plant grew and of plant maturity at the time cotton was harvested. Motes are removed from cotton during the ginning process by the gin stand moting system. A large proportion of motes in gin-loss cotton substantially lowers its quality. Trash and motes are the undesirable components in gin-loss cotton.

Usable fiber is the quality factor that determines the demand of gin-loss cotton by the cotton waste industry. The amount of usable fiber varies widely and depends upon type and condition of seed cotton and the kinds of machines used in harvesting and ginning. To be acceptable in the trade, gin-loss cotton must contain a reasonable percentage of usable fiber.

Length distribution of fibers is the greatest marketable asset of gin-loss cotton. Tests of typical gin-loss fibers from machine-picked cottons indicate that about 80 percent of the fibers are longer than one-half inch and are considered to be spinnable. Length distribution measurements show that 46.6 percent of the fibers in gin-loss cotton were longer than 1 inch compared with 61.7 percent in ginned lint (fig. 1).

Although overall length distribution of fibers in gin-loss cotton is slightly shorter than it is in ginned lint from the same bale, the spinnable fiber content of gin-loss cotton is still surprisingly high. Lack of a suitable method for separating the usable fibers from the undesirable trash and mote components has limited the industrial use of gin-loss cotton.

At present, nearly all marketable gin-loss cotton is utilized by the felting, or batting industry. Fiber length and the relatively low prices at which gin-loss cotton can be purchased are the two main reasons for its widespread use as a felting material. As a rule, the high content of trash and motes is the major complaint of dealers and users of this form of cotton waste.

A recent study of collecting and marketing gin-loss cotton showed that an improved method of removing trash was greatly needed.[1] Dealers indicated that they have ready markets for clean gin-loss cotton, but that they had difficulty in

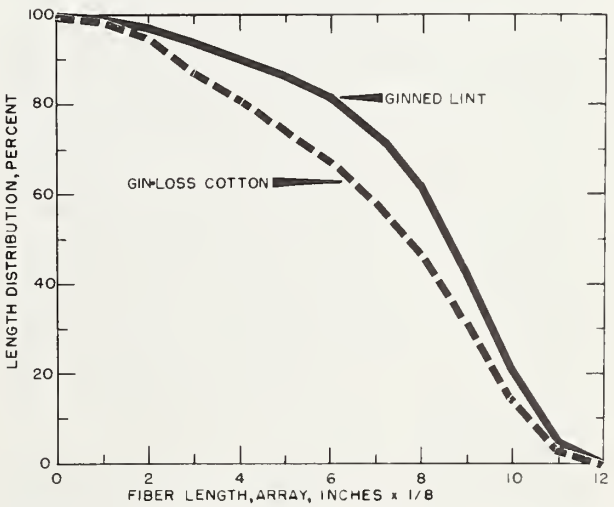

Figure 1.—Length distribution of fibers in gin-loss cotton and ginned lint from typical machine-picked cottons, based on fiber length array data.

[1] Holder, Shelby H., and Looney, Zolon M. reclaiming and marketing cotton gin motes. U.S. Dept. Agr. Econ. Res Serv., ERS–168. 1964.

trying to market and handle material that contains large quantities of trash and motes. Likewise, consumers complained of high shrinkage, or weight loss, and of musty odors that are attributed to the trash content of gin-loss cotton used in the felting mixes.

RESEARCH OBJECTIVES

In 1964 the U.S. Cotton Ginning Research Laboratory at Stoneville, Miss., and the Economic Research Service began a cooperative study to develop and evaluate a machine that would reclaim and clean gin-loss cotton. Major objectives of the study were: 1, Design a machine that would efficiently reclaim and clean usable or spinnable fibers of gin-loss cotton; 2, evaluate the machine in terms of its ability to separate fiber from trash; 3, determine fiber quality of reclaimed lint; 4, test the possibility of blending reclaimed gin-loss fibers with lint ginned from the same original bale; 5, evaluate the spinning performance of reclaimed gin-loss fiber and of blended lint; and 6, evaluate the economic aspects of reclaiming gin-loss cotton.

EXPERIMENTAL MACHINE

DESIGN

The experimental machine[2] makes use of no new cleaning principles, but it used modifications of principles already incorporated in cotton-cleaning machinery. A study of cleaning machines used in the cotton ginning and textile industries indicated that the combing and grid-bar action of conventional saw-type lint cleaners and other textile machinery would be the most logical and simplest means of reclaiming and cleaning gin-loss fibers. The principle of these machines consists of combing fibers from a relatively thin bat on a revolving saw cylinder and passing these fibers over a series of grid bars. The combined centrifugal force and brushing action removes the trash and other foreign matter. Cleaned fibers are then doffed from the saw cylinder by brush or other suitable means.

The combing and grid-bar principle of cotton cleaning consists of two main factors—combing ratio and saw type. Combing ratio is the ratio of surface speed of the saw cylinder to the speed at which the bat of fibers is fed onto the cylinder. Lint cleaners used in cotton gins have combing ratios between 10 to 1 and 20 to 1. Factors that control combing ratio for a given machine are processing capacity, saw speed, and saw diameter. Saw types are best described by tooth density, or number of teeth, per square inch of cylinder area. Saw types vary widely among lint cleaners currently in use. Tooth densities for cleaner cylinders range from 28 to 48 teeth per square inch. The trend in newer machines is toward the higher tooth densities.

The experimental cleaner was designed on the assumption that gin-loss fibers could be reclaimed and cleaned more efficiently at relatively high combing ratios and tooth densities. When high combing ratios and tooth densities are used, the incoming bat of gin-loss cotton is exposed to a greater number of saw teeth. Thus, each saw tooth engages fewer fibers. Under these conditions, trash and mote particles become less entangled in the usable fibers and are more likely to be removed as the fibers pass over the grid bars.

During preliminary investigations with the experimental cleaner, combing ratios of 45 to 1 and 105 to 1 were used. The higher ratio was more effective in reclaiming and cleaning gin-loss fibers and was adopted for further testing. Ratios higher than 105 to 1 may be advantageous from the standpoint of reclaiming and cleaning ability, but processing capacities prohibit their use.

Three cylinders equipped with different tooth densities and two tooth shapes were tested in the experimental machine. The first cylinder was covered with standard textile card clothing that provided a tooth density of 320 teeth per square inch of surface area. This cylinder performed satisfactorily from the standpoint of its ability to reclaim and clean. However, the thin, wirelike teeth on the card clothing were too fragile to withstand the abrasive action of the reclaiming and cleaning process. In addition, the high concentrations of trash particles in the gin-loss material caused severe clogging of the cylinder surface and created excess maintenance problems.

The second cylinder tested was covered with a textile-type doffer wire that had 14 teeth per inch of length. This wire covering was surface wound onto the cylinder at the rate of 28 turns per inch, giving a tooth density of 392 teeth per square inch. From the standpoint of reclaiming, cleaning, and durability, this wire proved to be very efficient. Clogging of trash particles between the rows of teeth on the cylinder again created problems, which made this wire impractical to use for this kind of an application.

Cylinder number three was also surfaced with the same textile doffer wire as used on cylinder number two. The wire was groove-wound onto the cylinder surface at the rate of 10 turns per inch, which provided a tooth density of 140 teeth per square inch. This cylinder also did a very

[2] The terms "experimental machine", "experimental reclaimer", and "experimental cleaner" as used in this Report are synonymous.

efficient job of reclaiming and cleaning gin-loss fibers and did it with considerably less clogging than did cylinder number two. The ease with which this type of cylinder cover can be cleaned reduces maintenance requirements. These advantages make cylinder number three effective for reclaiming and cleaning gin waste.

The experimental machine used in these studies was basically a commercial saw-type unit lint cleaner in which the combing ratio and saw type were modified as previously described. For experimental purposes, the machine was reduced to a length of about 1 foot and was equipped with a glass plate at one end in order to observe the reclaiming and cleaning actions. Figure 2 illustrates the working elements of the machine.

INSTALLATION

Requirements for installing the reclaimer into a ginning system are variable, depending on individual plant layout and design. In most gins, gin-loss cotton is moved away from the lint cleaners by air with fans specifically installed for this purpose. Moving this waste to a reclaimer, therefore, merely involves rearranging present duct work in order that existing fans can be utilized. Gin-loss material would be deposited pneumatically on the condenser of the reclaimer. Thus, adequate exhaust facilities need to be installed to handle the excess air volume from the condenser exhaust. Exhaust fan requirements would also be variable, depending upon volume of air supplied by the trash fans. Provisions also have to be made for moving trash and motes ejected by the machine during the reclaiming process. In practically all cases, motes and trash can be conveyed by utilizing existing trash fans. Reclaimed fibers can be moved from the machine in most instances by air from the reclaimer doffing system.

Facilities for packaging the reclaimed fibers would consist of a small-diameter condenser, tramper, and press. In many places tramping and pressing can be combined by use of a commercially available mote press. Suction for the condenser could be obtained from the same fan used for the cleaner-condenser exhaust.

Should the blending of reclaimed fibers into the original lint stream become an accepted practice, additional ductwork would be required to convey these fibers from the reclaimer into the lint flue. Blending should occur at a point in the lint flue immediately after the final stage of lint cleaning.

PERFORMANCE

Several series of tests were conducted in 1964 to evaluate, the overall performance of the experimental machine and to obtain the necessary data on capacity, trash removing capability, and fiber

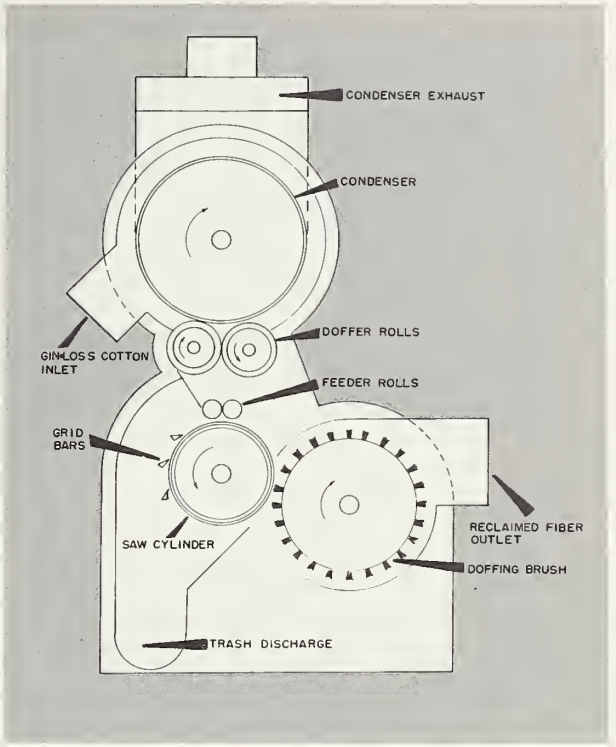

FIGURE 2.—End view of experimental reclaimer showing major functional parts.

reclaiming ability. These studies were also designed to provide data on fiber and spinning properties of reclaimed gin-loss cotton.

Preliminary studies involved processing lint cleaner waste through the machine at various feed rates to establish maximum, minimum, and optimum processing rates, and to determine the effect of processing rates on cleaning efficiency of the machine. The gin-loss cotton used in these tests had been baled and stored for 6 months.

Processing rates ranging from 20 to 100 pounds per hour per foot of cylinder width showed there was little or no difference in the reclaiming and trash-removing ability of the machine. Thus, the variable processing rates encountered in an actual ginning operation would have little or no effect upon machine performance.

Additional studies, which included both single- and multiple-processing of gin-loss cotton through the machine, were conducted during the 1964 ginning season. In the single-processing tests, gin-loss cotton produced by the first- and second-stage lint cleaners from early-, mid-, and late-season, machine-harvested cotton was used. During these studies seed cotton was processed through 2 stages of drying, 13 cylinders of cleaning, a bur machine, and an extractor-feeder. The cotton was ginned on a large-diameter saw, high-capacity gin. In the multiple processing studies, a given lot of gin-

loss cotton was passed through the experimental machine from one to three times. This material was also produced by the first- and second-stage lint cleaners from machine-harvested cotton.

Fiber reclaiming and trash removing abilities of the experimental machine are indicated by the foreign-matter content of the gin-loss material before and after cleaning (table 1). The general appearance of the gin-loss material before and after processing is shown in figure 3.

Results of single processing indicate that the machine reclaimed an average of 71.9 percent of the fibers (table 1) and removed an average of 84.3 percent of all foreign matter. Accordingly, the experimental machine was 71.9 percent efficient in fiber reclaiming ability and 84.3 percent efficient in cleaning ability. The overall efficiency of the machine was 60.6 percent, which is the product of reclaiming and cleaning efficiencies.

Results of the multiple-processing tests show that the percentages of weight loss, foreign matter content, and foreign matter removed decrease with each successive pass through the machine (table 1). The decrease in foreign matter and the increase in fibers removed from gin-loss cotton after each successive pass is an indication of the machine's reclaiming efficiency. Reclaimed fibers ranged from 60.0 percent in one pass to 86.8 percent in three passes through the experimental machine.

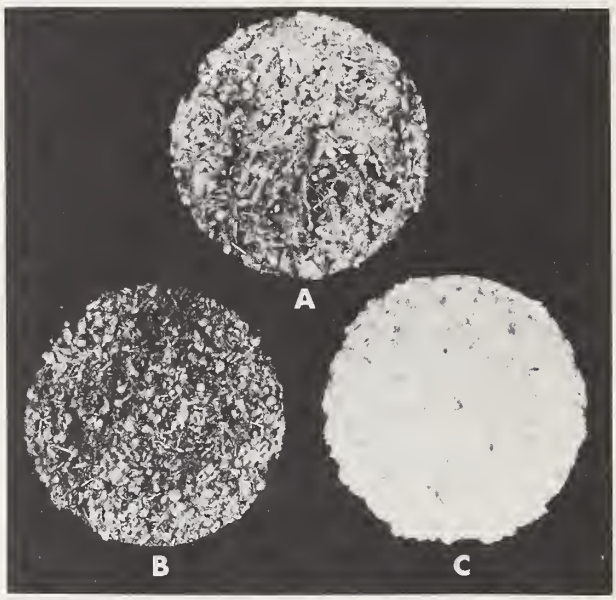

FIGURE 3.—Appearance of gin-loss material: *A*, before processing; *B*, trash and motes removed during the reclaiming and cleaning processes; and *C*, the reclaimed gin-loss fibers.

TABLE 1.—*Cleaning and reclaiming efficiency of experimental machine in processing gin-loss cotton*

Gin-loss cotton	Single processing				Multiple processing		
	Time of season [1]				Times processed [2]		
	Early	Mid	Late	Average	1	2	3
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Weight lost during processing	66. 6	58. 6	67. 3	64. 2	58. 3	31. 3	19. 2
Foreign matter content:							
Before processing [3]	67. 9	57. 8	66. 8	64. 2	52. 11	31. 39	14. 69
After processing	30. 1	24. 1	31. 1	28. 4	31. 39	14. 69	9. 03
Foreign matter removed	85. 3	82. 9	84. 8	84. 3	75. 1	66. 7	52. 5
Fibers reclaimed	72. 5	75. 0	68. 3	71. 9	60. 0	85. 8	86. 8

[1] Five ½-bale lots per season; 6 samplings per lot.
[2] 1 lot, weight before processing 110.8 pounds; 3 samplings per pass.
[3] Includes trash and motes.

QUALITY OF RECLAIMED FIBERS

Fiber properties of reclaimed gin-loss cotton were variable, depending on the time of season and the number of times processed (table 2). In single processing, upper quartile length of fibers obtained in various parts of the season ranged from 1.15 inches in midseason to 1.19 inches for late-season. The average was 1.17 inches. The effects of season on single processing are shown in table 2 for fiber mean length, variability of fiber length, and fibers shorter than one-half inch.

Multiple processing improved fiber quality as the result of successive passes through the machine (table 2). Upper quartile length increased to 1.18 inches and mean length to 0.89 of an inch. The variability of fiber length was reduced to 38 percent and fibers less than one-half inch to 17.5 percent.

QUALITY OF BLENDED LINT

Tests were also conducted during the 1964 season to study the feasibility of reincorporating, or blending, reclaimed gin-loss fibers with lint from the same original bale. This was accomplished by installing the experimental cleaner in the laboratory ginning system and pneumatically conveying gin-loss cotton from the first- and second-stage lint cleaners to the experimental cleaner for processing. Reclaimed gin-loss fibers were then blended into the original lint stream at a point between the final stage of lint cleaning and the battery condenser. Appropriate samples were taken before and after blending and were analyzed for various quality factors. These tests were conducted on early-, mid-, and late-season machine-picked cotton.

TABLE 2.—*Fiber properties of reclaimed gin-loss cotton*

Item	Single processing				Multiple processing			
	Time of season [1]				Times processed [2]			
	Early	Mid	Late	Average	0	1	2	3
Upper quartile length---inches	1. 17	1. 15	1. 19	1. 17	1. 12	1. 16	1. 13	1. 18
Mean length---do	. 91	. 87	. 89	. 89	. 80	. 86	. 86	. 89
Coefficient of variation---percent	37	40	42	40	47	43	41	38
Fibers less than ½ inch---do	16. 8	19. 5	19. 3	18. 5	25. 7	22. 1	19. 8	17. 5

[1] Five ½-bale lots per season; 6 samplings per lot.
[2] 1 lot, weight before processing 110.8 pounds; 3 samplings per lot.

An average of 8.5 pounds of reclaimed fibers was blended with each 500 pounds of ginned lint (table 3). Foreign matter, determined by use of the Shirley analyzer, ranged from 2.62 percent in blended lint to 2.29 percent in nonblended lint. This represents an increase in foreign matter attributable to blending of 1.6 pounds per bale. Thus, the average net gain in usable fiber for each bale was 6.9 pounds.

Only a slight difference in grade index occurred between blended and nonblended cottons (table 4). The color index for blended and nonblended cottons differed by an average of only 0.8 of an index point. The leaf index for blended and nonblended cottons differed by an average of only 0.2 of an index point. Composite grade index, which together with staple length determines the market price of cotton, ranged from 99.2 for blended cotton to 99.7 for nonblended. Both cottons were classified as Middling. Staple length was the same for both cottons—$1\frac{1}{16}$ inches.

Based on the 1964 loan price schedule for Middling $1\frac{1}{16}$-inch cotton, both the blended and nonblended cottons were valued at 31.62 cents per pound. The increase in bale weight of 8.5 pounds obtained by the reclaiming and blending processes resulted in an increase of $2.69 per bale for blended cotton over the nonblended cotton.

The effects of reclaimed gin-loss fibers on overall fiber quality of blended and nonblended cottons are shown in table 5. There were no important differences between the two cottons in upper quartile length, fiber mean length, coefficient of variation, and short fiber content. Thus, from the standpoint of comparative fiber data available from these tests, it appears that blending gin-loss fibers with lint from the same bale is feasible.

TABLE 3.—*Foreign matter in blended and nonblended cottons*

(Determined by Shirley analyzer)

Time of season	Weight of reclaimed fibers blended bale [1]	Foreign matter content	
		Blended [2]	Nonblended [2]
	Pounds	*Percent*	*Percent*
Early	9. 2	3. 34	2. 55
Mid	8. 4	2. 20	2. 04
Late	8. 0	2. 33	2. 28
Average	8. 5	2. 62	2. 29

[1] Weights obtained by collecting and weighing fibers reclaimed from nonblended lots.
[2] Five ½-bale lots per season; 6 samplings per lot.

TABLE 4.—*Classing results for blended and nonblended cottons*

Item	Time of season [1]						Average	
	Early		Mid		Late			
	Blended	Nonblended	Blended	Nonblended	Blended	Nonblended	Blended	Nonblended
Color----------index--	100. 0	101. 4	101. 1	102. 1	100. 0	100. 0	100. 4	101. 2
Leaf----------do----	100. 0	100. 0	100. 0	100. 0	94. 4	94. 8	98. 1	98. 3
Composite grade--do----	100. 0	100. 7	100. 5	101. 0	97. 2	97. 4	99. 2	99. 7
Staple length---inches--	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16	1 1/16

[1] Five ½-bale lots for blended and nonblended cottons per season; 6 samplings per lot.

TABLE 5.—*Fiber properties of blended and nonblended lint*

Item	Time of season [1]						Average	
	Early		Mid		Late			
	Blended	Nonblended	Blended	Nonblended	Blended	Nonblended	Blended	Nonblended
Upper quartile length inches--	1. 21	1. 22	1. 21	1. 22	1. 25	1. 26	1. 22	1. 23
Fiber mean length--do--	1. 01	1. 01	1. 00	1. 01	1. 01	1. 02	1. 01	1. 01
Coefficient of variation percent--	29	30	30	30	32	32	30	31
Fibers less than ½-inch --do--	8. 1	9. 2	9. 6	9. 2	10. 4	10. 2	9. 4	9. 5

[1] Five ½-bale lots of blended and nonblended cottons per season; 6 samplings per lot.

SPINNING PERFORMANCE

RECLAIMED FIBERS

Based on 5-pound samples of gin-loss cotton that had been processed only once through the experimental cleaner, studies indicate that it is possible to spin these fibers although manufacturing waste was excessively high and yarn quality was relatively low (table 6). Picker and card waste, neps, spinning end breakage, yarn strength, and break factor varied according to the season in which gin-loss fibers had been reclaimed. In all cases, yarn appearance index was 60, which indicated a below-grade appearance for yarn spun from reclaimed fibers of gin-loss cotton.

Multiple processing of gin-loss fibers through the experimental machine had very little effect upon spinning performace of the fibers (table 6). Reductions were noted in picker and card waste with each successive pass through the machine. Nep count was increased as a result of multiple cleaning, but no important differences were detected in yarn strength and appearance.

BLENDED LINT

The effects on spinning performance of blending single-processed reclaimed gin-loss fibers into the bale from which they originated was also investigated. Results obtained from 5-pound spinning lots indicated that the blending operation had very little effect upon spinning quality of early-, mid-, and late-season cottons (table 7). Manufacturing waste, resulting from picker and carding operations, was slightly higher for blended lint in each comparison. As previously shown in table 3, bale weight was increased by 8.5 pounds as a result of blending, but manufacturing waste increased only 1.5 pounds per bale. Thus, assuming that the entire increase of 1.5 pounds in picker and card waste occurred as a result of the blending, 7.0 pounds of blended material was utilized by the spinning process with no important changes in spinning properties.

Blended and nonblended cottons had 24 and 26 neps, respectively, per 100 square inches of card

TABLE 6.—*Spinning performance of reclaimed gin-loss cotton based on 5-pound spinning lots*

Item	Single processing [1]				Multiple processing [2]			
	Time of season				Times processed			
	Early	Mid	Late	Avg.	1	2	3	4
Fiber length:								
2.5-percent span—inches	1. 04	1. 04	1. 04	1. 04	1. 00	0. 98	1. 00	0. 99
Uniformity ratio—50/25 pct. UR	42	40	38	40	41	41	41	41
Manufacturing waste:								
Carding rate—pounds/hour	9. 5	9. 5	9. 5	9. 5	12. 5	12. 5	12. 5	12. 5
Weight fed first picker—pounds	5. 00	5. 00	5. 00	5. 00	4. 90	4. 50	3. 60	4. 00
Picker and card waste—percent	37. 1	31. 5	36. 9	35. 2	31. 2	21. 8	16. 7	15. 0
Neps in card web/1,000 sq. in	41	85	114	80	55	89	132	179
Spinning end breakage	Low	Low	Low	Low	Low	Low	Low	Low
Twist multiplier	4. 00	4. 00	4. 00	4. 00	4. 40	4. 40	4. 40	4. 40
Yarn strength and appearance:								
Carded 8s:								
Strength—pounds	262	238	203	234	241	240	247	246
Appearance [3]—grade	BG	BG	BG	BG	D	BG	BG	BG
Carded 22s:								
Strength—pounds	83	76	65	75	71	72	74	73
Appearance [3]—grade	BG	BG	BG	BG	BG	BG	BG	BG
Average break factor	1, 961	1, 788	1, 527	1, 759	1, 745	1, 752	1, 802	1,787
Average appearance index	60	60	60	60	60	60	60	60

[1] Five ½-bale lots per season; 1 composite spinning sample per season.
[2] 1 lot whose weight before processing was 75 pounds; 1 spinning sample per processing.
[3] BG=Below grade; D=Very poor.

TABLE 7.—*Spinning performance of blended and nonblended cottons based on 5-pound spinning lots*

Item	Time of season [1]						Average	
	Early		Mid		Late			
	Blended	Nonblended	Blended	Nonblended	Blended	Nonblended	Blended	Nonblended
Fiber length:								
2.5-percent span inches	1. 10	1. 11	1. 11	1. 11	1. 14	1. 14	1. 12	1. 12
Uniformity ratio 50/25-percent—UR	49	48	46	46	44	44	46	46
Manufacturing waste:								
Carding rate pounds/hour	9. 5	9. 5	9. 5	9. 5	9. 5	9. 5	9. 5	9. 5
Weight fed first picker pounds	5. 00	5. 00	5. 00	5. 00	5. 00	5. 00	5. 00	5. 00
Picker and card waste percent	7. 4	6. 9	7. 4	7. 3	8. 4	8. 1	7. 7	7. 4
Neps in card web	12	13	26	29	35	35	24	26
Spinning end breakage	Low	Low	Low	Low	Low	Low	Low	Low
Twist multiplier	4. 00	4. 00	4. 00	4. 00	4. 00	4. 00	4. 00	4. 00
Carded 22s:								
Strength—pounds	118	119	114	115	111	112	114	116
Appearance—grade	B	B	C+	C+	C	C	C+	C+
Carded 50s:								
Strength—pounds	41	41	40	40	39	39	40	40
Appearance—grade	C+	C+	C	C	D+	D+	C+	C+
Average break factor	2, 318	2, 324	2, 263	2, 277	2, 186	2, 204	2, 256	2, 268
Average appearance index	104	103	94	93	85	84	94	93

[1] Five ½-bale lots of blended and nonblended cotton per season; 1 spinning sample per lot.

web. Spinning and breakage were classified as low in all comparisons.

Strength and appearance of both 22s and 50s yarns were practically unchanged as the result of blending. The only difference noted was that yarn spun from nonblended lint was slightly stronger than that spun from blended lint. The average difference in break factor between blended and nonblended lints was too small to be of practical significance. The average appearance index was slightly higher for yarn spun from blended lint than it was for yarn spun from nonblended lint.

Even though test results indicate that blending of reclaimed fibers into the bale may be feasible, data from small spinning lots do not provide an adequate basis for recommending it as a practice. Studies of a larger and broader scope should be conducted to obtain more detailed data for evaluating the practice and as a basis for making recommendations to the ginning industry.

ECONOMIC ASPECTS OF RECLAIMING GIN-LOSS COTTON

Many factors need to be evaluated in determining the economic feasibility of reclaiming gin-loss cotton. Among these are the quantity of such waste that may be expected from gin plants having specified ginning rates; the cost of building and operating collecting and reclaiming facilities;[3] the effects of cleaning on weight loss and on value of gin-loss cotton; and the economic effects of an improved method of cleaning on demand for gin-loss cotton. These factors need to be evaluated from the standpoints of both ginner and industry.

SUPPLY OF GIN-LOSS COTTON

An average of about 13, 7, and 4 pounds of waste is removed by the first, second, and third stages of saw-type lint cleaning, respectively.[4] Based on these figures, individual and total production of gin-loss cotton can be estimated for gins in the United States.

The quantity of gin-loss cotton that can be produced at a given gin plant depends on total bales ginned per season, the stages of lint cleaning used, the degree to which gin-loss cotton is cleaned, and the resulting level of turnout. Knowing the ginning rate, ginners can estimate the volume of gin-loss cotton for their particular plant. For instance, if a ginner has a plant with a ginning capacity of 8 bales per hour and operates it for approximately 570 hours, he can expect to accumulate about 152 bales of uncleaned gin-loss cotton per season (table 8). If the ginner cleans the gin-loss cotton and gets a turnout of 40 percent, he can expect to reclaim 61 bales per season. Potential supplies of gin-loss cotton can be calculated in a like manner for other ginning operations.

Based on a 15-million-bale cotton crop, and assuming that lint cleaner waste is collected at all gins, an estimated 276 million pounds of such waste would be available for processing (table 9). Total pounds of actual fiber that would be reclaimable from this supply of lint cleaner waste depends on number of times it is processed. Based on turnout figures from this study, the total supply of reclaimed gin-loss fiber could range from approximately 64 million pounds if the total supply were triple-processed to about 115 million pounds if it were processed only once. It is not likely that all ginners could justify a reclaiming facility, nor would it be likely under present price structures that those having reclaiming facilities would process gin-loss cotton more than one time. Thus, the potential supply of gin-loss cotton probably would fall somewhere between the extremes for single-cleaning and no cleaning. Demand that might develop for reclaimed gin-loss cotton and its ultimate uses would dictate the extent to which it would be cleaned.

RECLAIMING COSTS

Buildings and Equipment

Total capital investment for reclaiming gin-loss cotton varies by several thousand dollars, depending on the type of facility installed and whether new or secondhand equipment is purchased. Costs range from $12,000 for a reclaiming facility to $7,300 for a collecting facility (table 10). The press and necessary motors are the most expensive items of equipment. Machinery costs can be reduced if an old gin press can be obtained and purchased at the price of used equipment.

The type of facility chosen for construction will be governed mainly by the gin capacity and the approximate volume of gin-loss cotton expected from a season's operation. For some low-volume ginning operations, the extra cost of purchasing reclaiming equipment would exceed the income from the operation.

[3] The term "collecting facility" as used in this Report refers to a gin-loss cotton-recovery system that does not have a cleaner comparable to the experimental model. The term "reclaiming facility" refers to a system that is equipped with a cleaner similar to the experimental model.

[4] Looney, Zolon M., LaPlue, L. D., Wilmot, Charles A., and others. Multiple lint cleaning at cotton gins, effects on bale value, fiber properties, and spinning performance. U.S. Dept. Agr. Econ. Res. Serv. Mktg. Res. Rpt. 601. 1963.

TABLE 8.—*Estimated accumulation of gin-loss cotton each season at stated ginning rates and levels of turnout* [1]

Level of turnout, percent [2]	Ginning rate in bales per hour						
	8	10	12	14	16	18	20
	Bales	*Bales*	*Bales*	*Bales*	*Bales*	*Bales*	*Bales*
100	152	190	228	266	304	342	380
75	114	142	171	200	228	256	285
70	106	133	160	186	213	239	266
65	99	124	148	173	198	222	247
60	91	114	137	160	182	205	228
55	84	104	125	146	167	188	209
50	76	95	114	133	152	171	190
45	68	86	103	120	137	154	171
40	61	76	91	106	122	137	152
35	53	66	80	93	106	120	133
30	46	57	68	80	91	103	114

[1] Accumulation of gin-loss cotton is in terms of 600-pound bales. The computations are based on an average gin-operating season of 570 hours, on a gin that uses 2 stages of lint cleaning, and on a turnout of 20 pounds of uncleaned (100-percent turnout level) or 8 pounds of cleaned (40-percent turnout level) gin-loss cotton per bale of ginned seed cotton.

[2] Turnout is the proportion of material reclaimed in relation to quantity of uncleaned gin-loss cotton, generally expressed as a percentage.

TABLE 9.—*Estimated potential annual supply of gin-loss cotton available under stated conditions*

Bales ginned [1]	Lint cleanings received	Lint waste		Potential supply available [3]		
		Removed per bale [2]	Available for processing	Times processed		
				1	2	3
	Number	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
4,635,000	1	13	60, 255, 000	25, 126, 335	17, 293, 185	13, 979, 160
8,325,000	2	20	166, 500, 000	69, 430, 500	47, 785, 590	38, 628, 000
2,040,000	3	24	48, 960, 000	20, 416, 320	14, 051, 520	11, 358, 720
15,000,000			275, 715, 000	114, 973, 155	79, 130, 205	63, 965, 880

[1] Assuming a 15-million-bale crop and that ginned lint from all bales will be cleaned. Distribution of waste was made according to the percent of gins having the specified number of lint cleaners. See data in "Cotton Gin Equipment," July 1964.

[2] LOONEY, ZOLON M., LAPLUE, L. D., WILMOT, CHARLES A., AND OTHERS. MULTIPLE LINT CLEANING AT COTTON GINS, EFFECTS ON BALE VALUE, FIBER PROPERTIES, AND SPINNING PERFORMANCE. U.S. Dept. Agr. Econ. Res. Serv. Mktg. Res. Rpt. 601. 1963.

[3] Weight-loss figures from multiple processing tests (table 15) were used to estimate the supply of gin-loss cotton that would be available if processed a specified number of times.

Fixed Costs

Total fixed costs are those that do not change as output increases. They include depreciation, interest on investment, insurance, and taxes. These costs continue at the same level, regardless of whether 1 bale or 300 bales of gin-loss cotton are recovered. Average fixed costs per bale are reduced by spreading them over a larger number of bales, but total fixed costs remain the same.

Depreciation, figured at 5 percent of replacement cost, was $600 for the reclaiming facility and $365 for the collecting facility (table 11). Based on these figures, depreciation costs for volumes of 100 and 300 bales per season range from $2 to $6 per bale for a reclaiming facility, and from $1.22 to $3.65 for a collecting facility.

Variable Costs

Variable costs are those that increase as output increases. For gin-loss collecting and reclaiming facilities, they consist of labor, bagging and ties, power, and repair of equipment.

TABLE 10.—*Building and equipment costs for collecting and reclaiming facilities*

Type of facility	Capital investment				Total
	Building [1]	Equipment			
		Press [2]	Reclaimer [3]	Miscellaneous [4]	
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Reclaiming	2, 500	6, 000	3, 000	500	12, 000
Collecting	2, 500	4, 500	--------	300	7, 300

[1] Building 20 feet wide, 30 feet long, and 15 feet high that has a concrete slab floor and is constructed of steel.
[2] Assumes that a secondhand press would be used in most collecting facilities and that a new mote press would be used in reclaiming facilities.
[3] Reclaimer consists of a modified secondhand lint cleaner.
[4] Consists of additional costs—piping, wiring, and other needed items.

TABLE 11.—*Seasonal fixed and variable costs for gin-loss cotton collecting and reclaiming facilities* [1]

Item	Facility	
	Reclaiming	Collecting
Seasonal fixed costs:	*Dollars*	*Dollars*
Depreciation	600. 00	365. 00
Interest on investment	300. 00	182. 50
Insurance	69. 12	42. 05
Taxes	53. 04	32. 27
Total	1, 022. 16	621. 82
Seasonal variable costs: [2]		
Labor	285. 00	570. 00
Power	379. 56	168. 89
Repairs	75. 00	50. 00
Total	739. 56	788. 89
Seasonal total costs	1, 761. 72	1, 410. 71

[1] Based on an average gin-operating season of 570 hours and a combined building and equipment cost for reclaiming and for collecting facilities of $12,000 and $7,300, respectively.
[2] To simplify estimates for operations of various sizes, no allowance was made for bagging and ties. To estimate per bale costs for collecting or reclaiming gin-loss cotton, the ginner would divide the number of bales he expects to collect or reclaim into the appropriate total cost figure, and add his cost of bagging and ties.

Since little or no waste is removed by a collecting facility, less time is needed to accumulate a bale of gin-loss cotton with this setup than with a reclaiming facility. For this reason, a full-time attendant is generally required at a collecting facility but not at a reclaiming facility. Labor is, therefore, one of the most important variable costs of operating a collecting facility, and it exceeds the costs of bagging and ties except when comparatively high volumes of gin-loss cotton are handled. Because reclaiming a bale of gin-loss cotton takes more time than it does to collect a bale, the attendant can be detailed to do odd jobs, except when he is making routine checks on the facility or when he is tieing out a bale. Thus, only one-half of an attendant's time was assigned to the costs of a facility equipped with a reclaimer. As a result, labor costs for a reclaiming facility will, in most cases, be less than those for a collecting facility.

Electrical energy is one of the most important variable costs of operating a reclaiming facility because more time and energy are needed to reclaim a bale than to collect a bale of gin-loss cotton and because of variation in ginning rates. If the average turnout of cleaned gin-loss cotton is 8 pounds per bale, 3.75 hours are needed to accumulate a 600-pound bale at a ginning rate of 20 bales per hour (table 12). If the ginning rate is 8 bales per hour, 9.38 hours are needed to accumulate a bale. These examples show that energy can range in cost from $2.50 to $6.25 per bale of cleaned gin-loss lint, depending on the ginning rate.

Total Costs

Total seasonal fixed and variable costs of reclaiming and collecting facilities were estimated to be approximately $1,762 and $1,411, respectively, less bagging and ties (table 11). Costs of bagging and ties were omitted to simplify the calculation of per bale costs for various ginning rates and volumes of gin-loss cotton. A ginner can approximate the per bale cost of collecting or reclaiming gin-loss cotton by dividing his expected seasonal output into the appropriate total cost figures shown in table 11 and adding the cost of bagging and ties.

Bale costs for accumulating gin-loss cotton at a collecting facility ranged from $5.91 for a plant that gins 20 bales an hour and has a gin-loss turnout at the 100-percent level to $11.48 for a plant that gins 8 bales an hour (table 13). Bale costs for a reclaiming facility are variable, depending on the percent of turnout. If 100 pounds of uncleaned gin-loss cotton is produced and yields only 40 pounds of reclaimed material, the turnout is 40 percent. The lower the percentage of turnout, the higher the cost per bale of reclaimed fiber. For example, a plant with a ginning rate of 14 bales per hour and equipped with a reclaiming facility has a reclaiming cost of approximately $11 per bale at a turnout of 75 percent and of over $24 per bale on a turnout of 30 percent.

TABLE 12.—*Energy, cost, and time required to accumulate a 600-pound bale of cleaned and uncleaned gin-loss cotton at stated ginning rates*

Ginning rate per hour—bales	Energy and cost per bale for—[1]				Time per bale for—[2]	
	Reclaiming		Collecting		Reclaiming	Collecting
	Kw.-hr.	*Dollars*	*Kw.-hr.*	*Dollars*	*Hours*	*Hours*
8	189	6. 25	34	1. 11	9. 38	3. 75
10	151	4. 99	27	. 89	7. 50	3. 00
12	126	4. 16	22	. 74	6. 25	2. 50
14	108	3. 57	19	. 63	5. 36	2. 14
16	94	3. 12	17	. 56	4. 69	1. 88
18	84	2. 78	15	. 49	4. 17	1. 67
20	76	2. 50	13	. 44	3. 75	1. 50

[1] Based on an energy cost of 29.63 cents per hour for a collecting facility, and 66.59 cents per hour for a reclaiming facility. Kilowatt-hour rate was figured at 3.3 cents.

[2] Accumulation time was based on turnouts of 8 pounds of cleaned fiber and 20 pounds of uncleaned fiber per bale ginned.

TABLE 13.—*Costs per bale to accumulate gin-loss cotton at stated levels of turnout and rates of ginning* [1]

Level of gin-loss turnout—percent	Ginning rate in bales per hour						
	8	10	12	14	16	18	20
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
100 [2]	11. 48	9. 62	8. 39	7. 50	6. 84	6. 32	5. 91
75	17. 65	14. 61	12. 50	11. 01	9. 93	9. 08	8. 38
70	18. 82	15. 45	13. 21	11. 67	10. 47	9. 57	8. 82
65	20. 00	16. 41	14. 10	12. 38	11. 10	10. 14	9. 33
60	21. 56	17. 65	15. 06	13. 21	11. 88	10. 79	9. 93
55	23. 17	19. 14	16. 29	14. 27	12. 75	11. 57	10. 63
50	25. 38	20. 74	17. 65	15. 45	13. 79	12. 50	11. 47
45	28. 11	22. 68	19. 30	16. 88	15. 06	13. 64	12. 50
40	31. 08	25. 38	21. 56	18. 82	16. 64	15. 06	13. 79
35	35. 44	28. 89	24. 22	21. 14	18. 82	16. 88	15. 45
30	40. 50	33. 11	28. 11	24. 22	21. 56	19. 30	17. 65

[1] Data in tables 8 and 11 provide the basis for per bale cost determinations. Bagging and ties were figured to cost $2.20 per bale.

[2] Turnout level of 100 percent is equivalent to 20 pounds of uncleaned gin-loss cotton and the 40-percent level, to 8 pounds of cleaned gin-loss cotton per bale of ginned cotton.

RETURNS FROM PROCESSING GIN-LOSS COTTON

If a ginner is considering the installation of a reclaiming facility, then value of the gin-loss cotton before and after processing has to be determined. Value involves not only price before and after processing, but also must take into consideration the weight loss resulting from the reclaiming process. To get a representative picture of value over an entire season, samples were collected during early-, mid-, and late-periods of ginning. These samples were evaluated by cotton waste dealers, and the average price that they would have paid for lots comparable to the quality of the samples was used as a basis for determining whether or not processing was profitable.

Effects of Processing on Value and Weight Loss

The average price buyers quoted for uncleaned gin-loss cotton was 1.50 cents per pound (table 14). The average price buyers offered to pay for gin-loss fibers that had been single processed by the experimental cleaner ranged from 6.0 to 7.5 cents per pound; it averaged 6.67 cents for the 1964 ginning season. The bale value of processed test lots increased an average of $5.47 after allowing for weight loss. Midseason gin-loss cotton had less foreign matter than that ginned in other parts of the season, and the price and turnout were better.

Based on average prices for the season, a 600-pound bale of unprocessed gin-loss cotton was worth $9 and after processing, $40.02. However,

TABLE 14.—*Average and total values of gin-loss cotton before and after processing, 1964 season*

Time of season	Average value per pound—		Weight loss	Value of a 600-pound bale of gin-loss cotton—		Increase in bale value attributed to processing [2]
	Before processing	After processing		Before processing	After processing [1]	
	Cents	*Cents*	*Percent*	*Dollars*	*Dollars*	*Dollars*
Early	1.00	6.00	66.6	6.00	12.02	6.02
Middle	2.00	7.50	58.6	12.00	18.63	6.63
Late	1.50	6.50	67.3	9.00	12.75	3.75
Average	1.50	6.67	64.2	9.00	14.47	5.47

[1] Based on value after processing, adjusted for weight loss.
[2] Difference between value before and after processing.

with an average season's turnout of 35.8 percent, as experienced in this study, 2.79 bales of uncleaned gin-loss cotton were needed to produce one bale of cleaned cotton. At 1.50 cents per pound, the 2.79 bales are worth $25.11. Using per bale cost figures for a plant with an average ginning rate of 14 bales per hour (table 13), it costs $20.92 to collect the 2.79 bales of uncleaned material, and $20.77 to reclaim a bale of cleaned material. Hence, net profit for the uncleaned gin-loss cotton is $4.19, compared to $19.25 for the cleaned material. Therefore, the cleaning operation returned a profit of $15.06, or approximately $5.40 per bale, above that of uncleaned gin-loss cotton. Any savings on storage and transportation which are realized because of the 1.79 fewer bales can also be added to this profit. Under these conditions, even the plant with a ginning rate of 8 bales per hour could realize a greater profit by selling a cleaned product. It would cost this plant $34.74 to reclaim a bale of cleaned fiber, which would return a net profit of $5.28 per bale, compared with a net loss of $6.92 on the 2.79 bales of uncleaned gin-loss cotton.

Tests were also made to determine whether multiple processing of gin-loss cotton was profitable. Gin-loss material was processed by the experimental cleaner from one to three times, and samples were collected before and after each processing. The average value before processing was 2 cents per pound, and after only one processing it increased to 6.5 cents per pound (table 15). After triple processing, the average value per pound increased to more than five times the original value. However, when weight loss was taken into account, a net decrease in total profit occurred after the first processing. Consequently, under present prices and markets, multiple processing of gin-loss cotton is not profitable at the gin.

More than three-fourths the weight of the original unprocessed material was lost in triple cleaning (table 15). Total and per-pass weight losses are somewhat variable within and between seasons, depending on the amount of trash in the unprocessed gin-loss material.

Determination of Break-Even Price

If the ginner knows what it costs to collect or to reclaim gin-loss cotton, he can easily determine the price he needs to receive for it in order to break

TABLE 15.—*Values of gin-loss cotton before and after multiple processing, 1964 season*

Times processed	Weight [1]		Weight loss		Average value per pound		Total value		Effect of processing on value
	Before processing	After processing	Per pass	Cumulative	Before processing	After processing	Before processing	After processing [2]	
	Pounds	*Pounds*	*Percent*	*Percent*	*Cents*	*Cents*	*Dollars*	*Dollars*	*Dollars*
0	600				2.00		12.00		
1	600	250	58.3	58.3	2.00	6.50	12.00	16.26	+4.26
2	250	172	31.2	71.3	6.50	8.50	16.26	14.62	−1.64
3	172	139	19.2	76.8	8.50	10.50	14.62	14.60	−.02

[1] Test weights adjusted to a 600-pound bale.
[2] Adjusted for weight loss.

even. For example, if it costs $10 to collect a 600-pound bale of gin-loss cotton, the ginner will have to get 1.67 cents per pound to break even (fig. 4). If the current market price of uncleaned gin-loss cotton were only 1.5 cents per pound, the ginner could not afford to bale it. However, he might sell it profitably in loose form to a cotton-waste processing plant. Since fixed costs of the collecting facility are continuous, sales to the processing plant would help cover fixed costs until the market price made it again profitable to collect and bale gin-loss cotton. For some low-volume ginning enterprises, the only profitable means of disposing of gin-loss cotton is to sell it to a cotton-waste processing plant.

A ginner having reclaiming, or cleaning, equipment may find it is profitable to clean his gin-loss cotton, even when the sale price of the uncleaned product is not enough to cover collecting and baling costs. If the processing cost were $25 per bale at a 40-percent turnout, the ginner would have to get 4.17 cents per pound to break even. With the market price of 6.5 cents per pound, the ginner could get $39 for a 600-pound bale of clean gin-loss cotton or $14 above cost. However, if the sale price allowed a profit of only $9 per bale, it would be just as profitable to sell uncleaned gin-loss cotton to a cotton-waste processing plant for 1.5 cents per pound, assuming the waste would be picked up at the gin at that price.

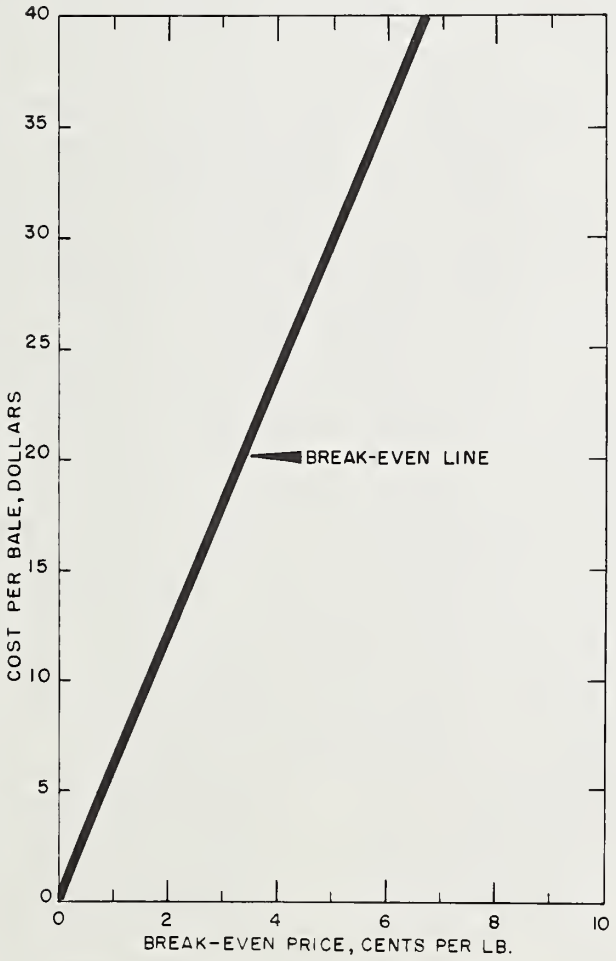

FIGURE 4.—Sale prices needed to balance costs of collecting or reclaiming gin-loss cotton.

ECONOMIC IMPLICATIONS

If present market trends are an indication of future developments, the disposal of baled, uncleaned gin-loss cotton through waste dealers will become even more difficult than it is now, and it may become impossible. Unless dealers handle large enough volumes of gin-loss cotton to justify owning a cotton-waste processing plant, only a few of them are willing to take the risks involved in buying very trashy bales. Under present market conditions, dealers are now offering only 1 or 2 cents per pound for qualities of uncleaned gin-loss cotton they were buying a few years ago for 3 to 5 cents per pound.

The current price situation may only be a temporary adjustment to the demand-and-price situation or it may indicate an increase in competition from other types of cotton waste that are readily substituted for gin-loss cotton in many end uses. However, if the present price trend reflects a more permanent adjustment to a changing market situation, then demand is shifting to a cleaner product. Should this be true, the demand for uncleaned gin-loss cotton in bale form will continue to weaken.

In the event the market of the future should be weak for baled gin-loss cotton, the ginner has three alternatives: (1) Not recover gin-loss cotton; (2) to sell his gin-loss cotton in loose form to a cotton-waste processing plant; or (3) to install a reclaiming facility. If the ginner already has a collecting facility but does not wish to install a reclaimer, his best alternative probably is to sell his gin-loss cotton to a processing plant, if such a plant is in his area. If he cannot dispose of the material in loose form, he will either have to install a reclaimer or shut down his collecting facility.

If price relationships for clean and uncleaned gin-loss cotton remain about the same, single-cleaning will be profitable at most gins. However, operators of plants that gin less than 8 bales per hour and that accumulate very low seasonal quantities of gin-loss cotton should carefully evaluate all costs and alternatives before investing in collecting and reclaiming facilities.

Some low-count yarns and special fabric constructions are manufactured from various mixtures of cotton waste and staple cotton. If in such

mixtures multiple-cleaned gin-loss cotton were to be accepted as a substitute for spinnable cotton waste, important new outlets would be opened for gin-loss cotton. At present, most gin-loss cotton is used by commercial felters in the manufacture of various types of cotton batting. The top price that most buyers pay for raw material used in batting is about 10 cents per pound. Under such a price ceiling and with the present differentials between uncleaned and single-cleaned gin-loss cotton, the most profitable practice is to process only one time. However, if differentials were to widen, double and triple cleaning of gin-loss cotton could become more profitable than single cleaning. Prices paid for a spinnable, reclaimed fiber should be high enough to make second and third cleaning an economical practice at gins as well as at cotton-waste plants.

Blending reclaimed fiber into the cotton bale as it is ginned would necessitate changes in statutes and trade rules, which now govern trading in cotton. However, if blending should become acceptable to the trade, it would increase farmer incomes by millions of dollars. Approximately 8 pounds of reclaimed fiber could be blended into a 500-pound bale. This is about 2 percent of the weight of the bale. Based on a price of 30.37 cents per pound, which was the average price received by farmers for upland cotton during the period June 1964 to February 1965, the bale value could be increased $2.43. For a 15-million-bale crop, this would have increased farm income $36,450,000. The cleaning of gin-loss cotton and its blending with lint from the original bale probably would be provided as a service to the customer at no extra charge—similar to the way lint cleaning is handled at present.

Blending reclaimed fiber into the gin bale could also provide a means of lowering the price of cotton. Assuming an average of 8 pounds were to be blended into a 500-pound bale worth 30 cents per pound, the price could be reduced by approximately 47 points per pound without reducing farmer incomes per bale. For example, a 500-pound bale of ginned lint worth 30 cents per pound would sell for $150, but a bale of blended lint weighing 508 pounds could be sold for 29.53 cents per pound and still give the farmer a return of $150.

SUMMARY AND CONCLUSIONS

Studies were begun in 1964 to develop and evaluate a new and better method of reclaiming and cleaning gin-loss cotton. As a result, a machine was developed for reclaiming the usable fibers from gin-loss material.

Tests during the 1964 ginning season showed that the machine could reclaim an average of about 72 percent of the usable fibers and remove 84.3 percent of the foreign matter from gin-loss cotton in one processing. Tests also showed that processing slightly improved the length distribution of gin-loss fibers and made it feasible to spin a mix consisting of 100 percent reclaimed fibers. Although manufacturing waste was high and yarn strength and appearance were relatively low when only reclaimed fibers were used in yarns, such fibers should perform satisfactorily in mixes used to manufacture certain low-count yarns and fabric constructions.

Estimates show that a capital investment of approximately $7,300 is needed for a collecting facility and about $12,000 for a reclaiming facility equipped with a cleaner comparable to the model developed in this study. Per bale costs for recovering gin-loss cotton with either of these facilities are variable, depending mainly on the number of bales collected or processed.

Buyers offered an average of 1.5 cents per pound for unprocessed gin-loss cotton and 6.67 cents per pound after it was processed. Based on these prices, adjusted for weight loss, the value of gin-loss cotton increased by more than $5 per bale after having been passed only one time through the reclaimer. However, current price relationships and market demands make it unprofitable to run the material through the reclaimer more than one time.

Few dealers purchase gin-loss cotton that contains large quantities of trash. If their reluctance to do this is an indication of a weakening demand for uncleaned gin waste, then most ginners who collect their gin-loss cotton will find it necessary to install an efficient cleaner.

The feasibility of blending reclaimed gin-loss fibers with lint from the same bale was also investigated. At blending rates averaging 8.5 pounds of reclaimed fiber per bale, no important differences were noted in grade, staple length, fiber properties, and spinning performance between blended and nonblended cottons. Based on current market prices, blending increased the bale value of Middling $1\frac{1}{16}$-inch cotton by $2.69. However, definite conclusions regarding the practice of blending cannot be made because of the limited scope of this phase of the study. More detailed and comprehensive studies are needed to fully evaluate this practice.

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